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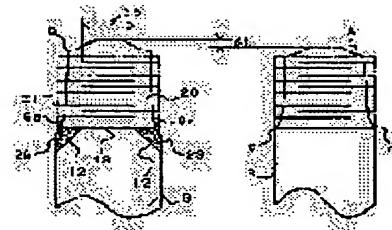
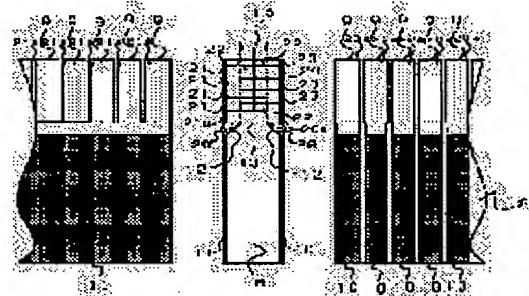
JP

(54) INK JET TYPE RECORDING HEAD

(57)Abstract:

PURPOSE: To improve energy efficiency without generating useless stress in a laminated type piezoelectric vibrator by a method wherein the piezoelectric vibrator of an ink jet type recording head and its fixed substrate form their area only in an active area, and are fixed only in that area.

CONSTITUTION: When a driving signal is impressed to a piezoelectric vibrator 9, an active area 15 put between both electrodes 20..., 21... is elongated in an electrode arranged direction. Further, an inactive area which does not receive an electric field does not contribute to elongation. Then, the vibrator 9 is supported with a fixed substrate 8 only in an active area 15 wherein both electrodes 20..., 21... lap over. Further, the inactive areas on both sides are fixed with conductive adhesives 28, 29 equipped with elasticity, and edge parts 9a, 9a are maintained in a free state. Therefore, they push a diaphragm without receiving restriction with the substrate 8. Then, the whole of a bottom face of a vibrator A is fixed with the fixed substrate 8, and variation in elongation is increased by  $\Delta L$  as compared with conventional one. Energy efficiency generating an ink liquid is raised. At the same time, the edge parts 9a, 9a are not restricted, and fatigue is decreased.



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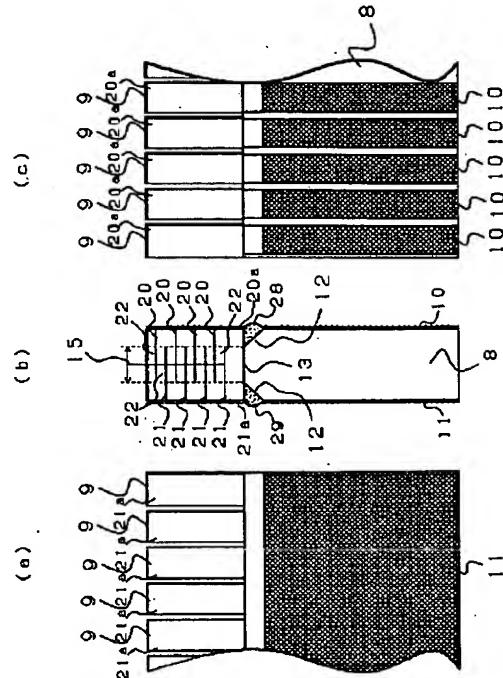
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(54)【発明の名称】 インクジェット式記録ヘッド

(57)【要約】

【目的】 壓電材料と電極形成材料とを積層するとともに、両側に引出電極を設けた圧電振動子を用いたインクジェット式記録ヘッドにおける、圧電振動子のエネルギー効率の向上とストレスの低減を図ること。

【構成】 圧電材料22と電極形成材料を交互に積層してセグメント電極20とコモン電極21を中央部で上下関係となるようにして活性領域15を形成した圧電振動子9と、圧電振動子9を固定する固定基板8と、圧電振動子9の先端に当接して圧電振動子9の伸縮によりインクを圧縮してインク滴を発生する流路構成部材とを備えたインクジェット記録ヘッドであって、圧電振動子9と固定基板8とを活性領域15の部分でのみ当接させて接着剤により固定する。圧電振動子9の電極20、21に駆動信号が印加されると、各極の電極が対向している活性領域15だけが積層方向に伸長する。伸縮に預からない側面のエッジ部が固定基板8に対してフリーな状態におかれているから、活性領域15の伸長に可及的に追従して縮小することになる。



## 【特許請求の範囲】

【請求項1】 セグメント電極及びコモン電極となる電極形成材料と圧電材料とを交互に積層し、中央部に活性領域を形成して積層方向に伸縮するように構成された圧電振動子と、該圧電振動子を固定する固定基板と、前記圧電振動子の先端に当接し、前記圧電振動子の伸縮によりインクを圧縮してインク滴を発生する流路構成部材とを備えたインクジェット式記録ヘッドにおいて、前記圧電振動子と前記固定基板とが前記活性領域の部分でのみ当接領域を形成し、かつ前記当接領域だけで両者が固定されていることを特徴とするインクジェット式記録ヘッド。

【請求項2】 前記固定基板の前記圧電振動子に当接する側に、前記圧電振動子の活性領域に対向する部分を残して斜面を形成するように切り落とし部が形成されている請求項1のインクジェット式記録ヘッド。

【請求項3】 前記固定基板が、前記圧電振動子の活性領域に対向する部分に形成された凸部が形成され、前記凸部により前記圧電振動子の活性領域と接している請求項1のインクジェット式記録ヘッド。

【請求項4】 前記圧電振動子が、前記固定基板に当接する側の前記活性領域以外の部分に切り落とし部が形成されていて、活性領域だけが固定基板に当接して固定された請求項1のインクジェット式記録ヘッド。

【請求項5】 前記圧電振動子が、セグメント電極及びコモン電極を構成する電極形成材料の厚みにより活性領域に突出部を有していて、前記突出部を固定基板に当接させて固定されている請求項1のインクジェット式記録ヘッド。

【請求項6】 前記切り落とし部により形成される空間に固化後も弾性を維持する接着剤が充填されている請求項1乃至5のインクジェット式記録ヘッド。

【請求項7】 前記接着剤が導電性を備えていて、圧電振動子と固定基板に形成されているリード電極との電気接続を行っている請求項1乃至6のインクジェット式記録ヘッド。

【請求項8】 セグメント電極及びコモン電極となる電極形成材料と圧電材料とを交互に積層し、中央部に活性領域を形成して積層方向に伸縮するように構成された圧電振動子と、該圧電振動子を固定する固定基板と、前記圧電振動子の先端に当接し、前記圧電振動子の伸縮により振動板を介してインクを圧縮してインク滴を発生する流路構成部材とを備えたインクジェット式記録ヘッドにおいて、前記圧電振動子は、前記固定基板及び前記振動板と前記活性領域の部分でのみ当接領域を形成し、かつ前記当接領域だけで両者が固定されていることを特徴とするインクジェット式記録ヘッド。

【請求項9】 前記振動板と前記圧電振動子とは、前記活性領域に対応するサイズの連結部材を介して固定され

ている請求項8のインクジェット式記録ヘッド。

【請求項10】 前記連結部材が振動板に一体に構成されている請求項9のインクジェット式記録ヘッド。

【請求項11】 前記圧電振動子は、前記振動板に対向する側の不活性領域が一部切り落とされて実質的に活性領域とだけ固定されている請求項8のインクジェット式記録ヘッド。

## 【発明の詳細な説明】

## 【0001】

10 【産業上の利用分野】 本発明は、圧電材料と電極材料をサンドイッチ状に積層した圧電振動子を駆動手段に用いたインクジェット式記録ヘッドに関する。

## 【0002】

【従来の技術】 圧力発生室に収容されているインクに圧力を加えてノズル開口からインク滴を発生させるインクジェット記録ヘッドは、圧力発生室に発熱素子を収容してなるサーマルジェット式のものと、圧力発生室を圧電振動子で押圧する圧電式の2つの形式に大きく分類され、後者のものは加熱を受けないためインクに変質を来さず、カラー印刷等広い用途に使用できるという特徴を備えている。しかしながら、インク滴を発生させるに足る変位を圧電振動子に生じさせるためには、数100ボルト程度の駆動電圧が必要になり、信号伝送路や回路部品に大きな耐圧性が要求されるという問題を抱えている。このような問題を解消するために例えば特開平4-1052号公報に示されたように、圧力発生室を圧縮、膨張させるための圧電振動子を、圧電材料と電極材料を複数層サンドイッチ状に積層して構成したものが提案されている。これによれば、駆動電圧を30ボルト程度に引き下

20 げることができ、駆動回路や給電手段の構造を簡素化することができる。

【0003】 しかしながら、圧電材料と電極形成材料という異なる材料を積層している関係上、单一の圧電振動基板を用いた圧電振動子に比較してその強度が低下するという不都合が有る。

## 【0004】

【発明が解決しようとする課題】 本発明はこのような問題に鑑みてなされたものであってその目的とするところは、積層型圧電振動子に無用な応力を生じさせることのなく、しかもエネルギー効率を向上させることができる新規なインクジェット式記録ヘッドを提供することである。

## 【0005】

【課題を解決するための手段】 このような問題を解消するために本発明においては、セグメント電極及びコモン電極となる電極形成材料と圧電材料とを交互に積層し、中央部に活性領域を形成して積層方向に伸縮するように構成された圧電振動子と、該圧電振動子を固定する固定基板と、前記圧電振動子の先端に当接し、前記圧電振動子の伸縮によりインクを圧縮してインク滴を発生する流

路構成部材とを備えたインクジェット式記録ヘッドにおいて、前記圧電振動子と前記固定基板とが前記活性領域の部分でのみ当接領域を形成し、かつ前記当接領域だけで両者を固定するようにした。

#### 【0006】

【作用】圧電振動子のセグメント電極、及びコモン電極に駆動信号が印加されると、各極の電極が対向している活性領域だけが積層方向に伸長する。このとき伸縮に預からない側面及び下端エッジ部が共に固定基板にフリーナ状態におかれているから、活性領域の伸長に可及的に追従して縮小することになる。この結果、圧電振動子のエッジ部の応力が、エッジ部が固定されている場合に比較して極めて小さく、しかも収縮側が拘束されていない分、電極配列方向の伸長度合が大きくなり、高い効率でインク滴を発生させることになる。

#### 【0007】

【実施例】そこで以下に本発明の詳細を図示した実施例に基づいて説明する。図1、及び図2は、それぞれ本発明の一実施例を示す組み立て斜視図と断面図であって、図中符号1はノズル開口2, 2, 2……が穿設されたノズルプレート、3は圧力発生室6を区画するための通孔4, 4, 4……を備えたスペーサ、5は後述する圧電振動ユニット7の圧電振動子9に当接し、圧電振動子9の伸縮に合わせて変形する振動板で、これら3つの部材を積層して圧力発生室6を形成する流路構成ユニットが構成されている。

【0008】7は、本発明が特徴とする圧電振動ユニットで、固定基板8の先端に積層型圧電振動子9, 9, 9……を固着し、固定基板8の側面に圧電振動子9, 9, 9と外部端子と接続するためのリード電極10, 10, 10……、11が形成されている。そして固定基板8は、その圧電振動子9, 9, 9……の側部に対向する部分を切り落として切り落し部12, 12が形成されていて、残部となる平面部13だけが圧電振動子9, 9, 9……の活性領域15(図3)に当接してこれを固定している。このように構成された流路構成ユニットと振動子ユニットとはインク供給路14を構成する構を備えた基台16, 16を介して相互に固定されて記録ヘッドにまとめ上げられている。

【0009】図3は、前述した振動子ユニット7の詳細を示す図であって、図中符号9は、圧電振動子で、セグメント電極、及びコモン電極を構成する電極形成材料、例えば銀パラジウムと、圧電材料、例えばチタン酸鉛とをそれぞれ3乃至5μm、及び20乃至50μmの厚みで、かつ一方の電極、つまり駆動信号を印加するセグメント電極20, 20, 20……となる電極形成材料とコモン電極21, 21, 21……となる電極形成材料を一端が圧電材料により形成される圧電振動層22, 22, 22……の側面まで延長され、また他端が中央部近傍で終端するように配置して、中央部でのみ各極の電極2

0, 21, 20, 21を重ね合わさるように積層される。

【0010】この状態で焼成すると、中央部においてセグメント電極20, 20, 20……とコモン電極21, 21, 21……が一定の幅でラップし、ここが電歪現象を生じる領域、いわゆる活性領域15となる。そして、セグメント電極20, 20, 20……が露出している側面、及びコモン電極21, 21, 21……が露出している側面に蒸着などにより側面電極20a, 21aを形成すると、各極20, 20, 20……、及び21, 21, 21……がそれぞれ側面電極20a、及び21aにより並列に接続され、30ボルト程度の低い電圧で圧力発生室6を構成している振動板5を押圧してインク滴を発生させるための変位を生じさせる電歪現象を生じることになる。

【0011】8は、前述の固定基板で、圧電振動子9の各電極が重なる部分、つまり活性領域15と対向する部分にだけ平面部13を有するよう、上面両側のエッジを切り落として切り落とし部12, 12が形成されている。コモン電極21, 21, 21……が露出する側の側面(同図A)にはその全面に蒸着などによりリード電極11が形成されており、またセグメント電極20, 20, 20……が露出する側の側面(同図C)には圧電振動子9, 9, 9……の位置に合わせて蒸着などにより複数条のリード電極10, 10, 10……が形成されている。

【0012】このように構成された固定基板8と圧電振動子9, 9, 9……は、固定基板8の頂点の平面部13に非導電性接着剤を可及的に薄く塗布して圧電振動子9, 9, 9……をほぼ固定基板8に当接させた状態で、ノズル開口2, 2, 2……の配列ピッチに一致させて固定して振動子ユニット7に構成されている。そして固定基板8の切り落とし部12, 12と圧電振動子9, 9, 9との端面とにより形成される断面V字状の空間には、側面電極20a側には圧電振動子9, 9, 9……の配列に合わせて、固化後も柔軟性を有する導電性接着剤28, 28, 28……を分離帯を設けるように注入し、また側面電極21aには全体に導電性接着剤29を注入する。

【0013】これにより、各圧電振動子9, 9, 9……のセグメント電極20, 20, 20……が側面電極20a, 20a, 20a……を介してそれぞれ独立したリード電極10, 10, 10……に、また圧電振動子9のコモン電極21, 21, 21……が側面電極21a共通のリード電極11に電気接続される。そしてこれらから、フレキシブルケーブル等の導電パターンをリード電極10, 10, 10……, 11に接続することにより、圧電振動子9, 9, 9……のそれぞれに選択的に駆動信号を供給することができる。

【0014】この実施例において、圧電振動子9に駆動

信号を印加すると、図4(a)に示したように両極の電極20, 20……, 21, 21……に挟まれた活性領域15が電極配列方向に伸長し、また、一方の電極しか存在せず、電界を受けない不活性領域は、伸長に寄与しない。そして圧電振動子9は、両極の電極20, 20, 20……, 21, 21, 21……がラップしている活性領域15だけが固定基板8に支持され、また両側の不活性領域は弾性を備えた導電性接着剤28, 29により固定されていてエッジ部9a, 9aが、圧電現象から見るとフリーな状態に維持されているから、圧電振動子全体としては固定基板8による拘束を受けることなく伸長して振動板5を押圧することになる。

【0015】この結果、圧電振動子Aの底面全体が固定基板Bに固定されて、エッジ部C, Cが拘束されている従来のもの(同図b)に比較して、その伸長の度合(体積変化率)が△Lだけ大きくなり、インク滴を発生させるためのエネルギー効率が高くなる。同時にエッジ部9a, 9aが拘束を受けていないためにストレスが小さくなり、疲労が減少する。

【0016】なお、この実施例においては個々に独立して構成した圧電振動子9, 9, 9……をノズル開口2, 2, 2……の配列ピッチに合わせて固定基板8に固定するようにしているが、図5に示したように、圧電材料30, 30……と電極形成材料31, 32, 31, 32……を交互に積層して一枚の板として構成された圧電振動板33を、その活性領域だけを切り落とし部37, 37を備えた固定基板34に接着剤で固定し、圧電振動板33の先端から固定基板34の表面に到達するスリット35, 35をダイヤモンドソウ36やワイヤソウにより形成すると、接着作業の簡素化を図ることができる。

【0017】図6は本発明の第2実施例を示すものであって、図中符号40は、前述した圧電振動子9を固定する固定基板で、圧電振動子9の活性領域15に対向する部分に凸部41が形成されていて、圧電振動子9の活性領域15だけに当接してこれを固定するように構成されている。この結果、圧電振動子9の不活性領域と固定基板40との間に空間42, 42が形成されることになり、前述の実施例と同様に圧電振動子9のエッジ部9a, 9aが圧電振動子9の伸縮時にフリーな状態に維持されるから、図7に示したように圧電振動子9は、駆動信号が印加されたときの伸長変位が大きく高い効率でインク滴を発生させると共に、無用な応力を受けることがなく、圧電振動子9や固定基板40の疲労を小さくすることができる。

【0018】いうまでもなく、固定基板40の側面にリード電極43, 44を形成して、空間42, 42に固化後も弾性を維持する導電性接着剤を充填することにより、圧電振動子9の側面電極20a, 21aと固定基板40のリード電極43, 44とを接続することができる。またこの実施例においても前述の図5に示したよう

に固定基板40に1枚の圧電振動板を固定して、圧電振動板だけを所定のサイズに切分けて製造できることは明らかである。

【0019】図8は、本発明の第3実施例を示すものであって、図中符号50は、圧電材料を挟むように電極形成材料が対向する向きに交互にサンドイッチ状に積層してセグメント電極52, 52, 52……とコモン電極53, 53, 53……を形成し、中央部に圧電振動層51の活性領域54を構成するようにした圧電振動子で、固定基板55に対向する側の不活性領域のエッジ部を切り落として切り落とし部56, 56が形成されている。

【0020】圧電振動子50は、その平面部57を接着剤により固定基板55に固定され、また切り落とし部56, 56と固定基板55とで形成されるV字状の溝には、固化後も弾性を維持する導電性接着剤58, 58を充填して、圧電振動子50の各側面電極52a, 53aとリード端子59, 60とが接続されている。

【0021】またこの実施例では振動板62に当接している圧電振動子50の他端側のエッジ部にもやはり切り落とし部63, 63が形成されていて、圧電振動子50と振動板62を固定する接着剤の逃げ部をなすように構成されている。これにより余分に塗布された接着剤が切り落とし部63, 63に流れ込み、振動板62と圧電振動子50との補強をなすと共に隣接する圧電振動子との隙間に流れ込むのを防止する。

【0022】この実施例において圧電振動子50に駆動信号を印加すると、活性領域54だけが伸長して振動板62を押圧して圧力発生室65を圧縮して、ノズル開口66からインク滴を発生させることになる。圧電振動子50は、駆動信号の印加による伸長に伴なって、図9に示したように伸長方向と直角方向に収縮することになるが、下端のエッジ部50a, 50aが切り欠かれているから、固定基板55による拘束を受けることがなく、したがって先端が大きく変形できて高いエネルギー効率でインク滴を発生させ、また圧電振動子50や固定基板55の疲労も小さくなる。

【0023】なお、上述の実施例においては、圧電振動子のエッジを研磨などにより切り落とし部を積極的に形成するようにしているが、図10に示したように、圧電振動材料を積層するにあたって一定の厚みを有するグリーンシート70, 70, 70……と電極形成材料のグリーンシート71, 71, 71, 71……を重ねていくと、電極が上下に重なる領域、つまり活性領域74となる部分が、他の部分よりも一方の極となる電極形成材料のグリーンシートの枚数だけ積層数が多くなるので、最終的には活性領域に段差△dの凸部75が生じることになる。

【0024】この状態で焼成して、図11に示したように凸部75を固定基板77に当接させて接着剤で固定する50ようにすると、不活性領域となる両側部に固定基板77

との間に空間78, 78が生じる。この結果、切り落とし部を形成するための特別な加工を要することなく、活性領域74だけを固定基板77に当接固定し、かつエッジ部をフリーな状態に維持させた圧電振動ユニットを構成することができる。

【0025】図12は本発明の第5実施例を示すものであって、図中符号80は前述したようにセグメント電極81, 81, 81…とコモン電極82, 82, 82…とを中央部で一部ラップするように配置して中央部にのみ活性領域83を形成した積層型圧電振動子で、活性領域83とだけ対向当接するように基台84に形成された凸部85に接着剤で固定され、不活性領域には基台84との間に空間86, 86を形成するようにして固定されている。そして、各セグメント電極81, 81, 81…、及びコモン電極82, 82, 82…を並列接続している側面電極81a, 82aは、その下端を基台84に設けられたリード電極87, 88に、固化後も弾性を維持する導電性接着剤89により固定されている。一方、圧力発生室90に対向する側は、やはり活性領域83にだけ接するようにサイズが選択された連結部材91を介して振動板92のアイランド部93に当接させて固定され、不活性領域と振動板92との間に空間94が確保されている。なお、図中符号95, 95は振動板92に形成された薄肉部を、また96は、ノズル開口97を備えたノズルプレートをそれぞれ示す。

【0026】この実施例において駆動信号が印加されると、圧電振動子80は、前述したように活性領域83だけが伸長して振動板92を押圧して圧力発生室90を圧縮して、ノズル開口97からインク滴を発生させることになる。圧電振動子80は、駆動信号の印加による伸長に伴なって、図13に示したように伸長方向と直角方向に収縮することになるが、下端の固定されていない不活性部80a, 80aが、圧電振動子80の変形に対しては弾性を示す導電性接着剤89, 89により固定されているだけであり、また上端側の固定されていない不活性部80b, 80bも振動板92に対してフリーな状態に保たれているから、圧電振動子80は、基台84や振動板92から収縮に対する拘束を受けることがなく、したがって、先端の全面が振動板に固定されている場合に比較して伸長度合がさらに大きくなる。したがって、より一層高いエネルギー効率でインク滴を発生させるとともに、圧電振動子80、基台84、及び振動板92の疲労も小さくなる。

【0027】なお、この実施例においては圧電振動子の活性領域と振動板とを接続する連結部材を別部材として構成しているが、振動板のアイランド部と一体に構成することができるばかりでなく、前述の図8に示したよう振動板側の不活性領域の一部切り落して、活性領域だけを振動板、もしくは振動板のアイランド部に当接固定するようにしても同様の作用を奏することは明らかである。

る。

【0028】

【発明の効果】以上、説明したように本発明においては、セグメント電極及びコモン電極となる電極形成材料と圧電材料とを交互に積層し、中央部に活性領域を形成して積層方向に伸縮するように構成された圧電振動子と、圧電振動子を固定する固定基板と、圧電振動子の先端に当接し、圧電振動子の伸縮によりインクを圧縮してインク滴を発生する流路構成部材とを備えたインクジェット式記録ヘッドにおいて、圧電振動子と固定基板とが活性領域の部分でのみ当接領域を形成し、この当接領域だけで両者を固定したので、圧電振動子のエッジ部に作用する応力を極めて小さくでき、しかも収縮側が拘束されていない分、電極配列方向の伸長度合が大きくなり、高い効率でインク滴を発生させることができる。

【図面の簡単な説明】

【図1】本発明の一実施例を示す斜視分解図である。

【図2】本発明の一実施例を示す断面図である。

【図3】(a)、(b)、(c)は、それぞれ同上装置20に用いる圧電振動ユニットの一実施例を両側面の構造を示す図である。

【図4】同図(a)、(b)は、それぞれ本発明の記録ヘッド、及び従来の記録ヘッドとに駆動信号を印加した時の伸張形態を示す図である。

【図5】同上圧電振動子の製造方法の一実施例を示す図である。

【図6】本発明の他の実施例を示す図である。

【図7】同上装置に駆動電圧を印加した時の状態を示す図である。

【図8】本発明の第3実施例を示す断面図である。

【図9】同上装置に駆動信号を印加した時の状態を示す図である。

【図10】積層型圧電振動子の一実施例を示す断面図である。

【図11】同上圧電振動子を使用した本発明の第4実施例を示す図である。

【図12】本発明の第5実施例を示す断面図である。

【図13】同上装置の動作を示す図である

【符号の説明】

40	1	ノズルプレート
	2	ノズル開口
	3	スペーサ
	4	圧力発生室
	5	振動板
	6	圧力発生室
	8	固定基板
	9	積層型圧電振動子
	10, 11	リード電極
	12, 13	切り落とし部
50	13	平面部

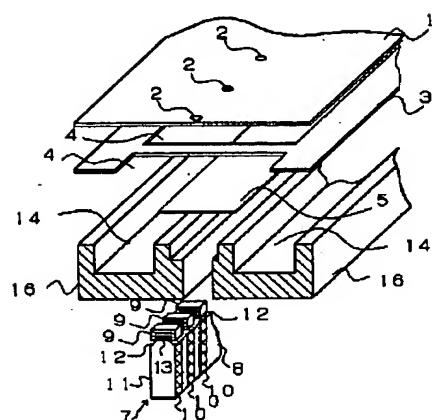
9

15 活性領域  
20 セグメント電極  
21 コモン電極  
22 圧電材料

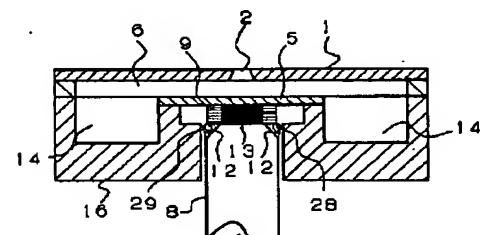
10

20a 側面電極  
21a 側面電極  
28, 29 導電性接着剤

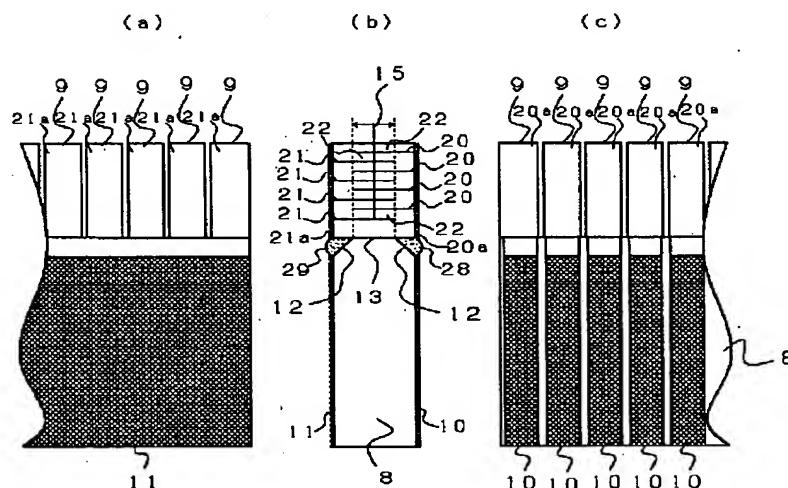
[図 1]



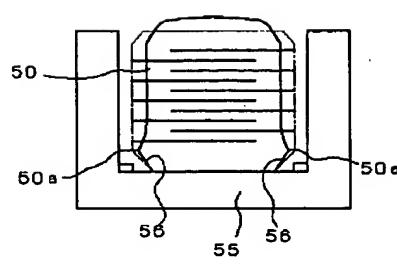
【図2】



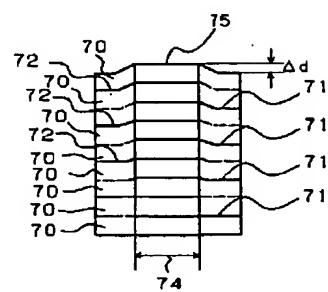
[図3]



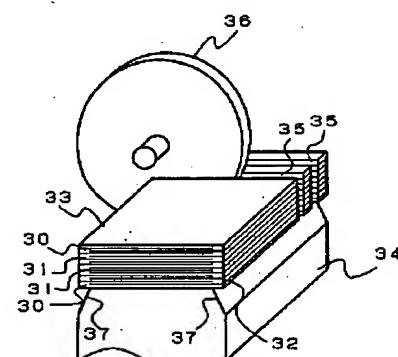
[ 9]



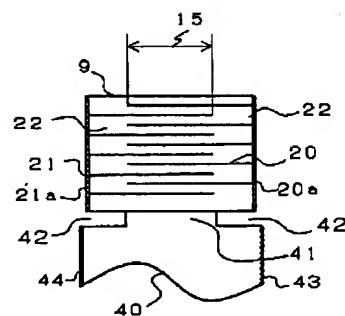
[図10]



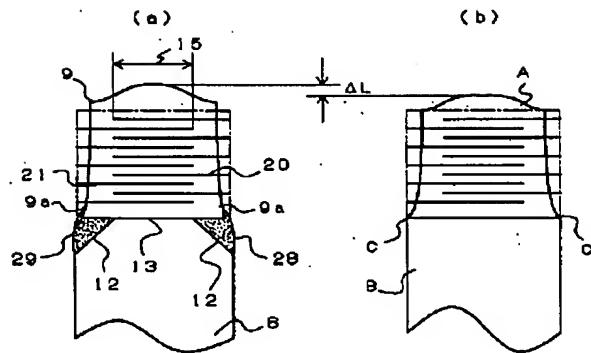
【图5】



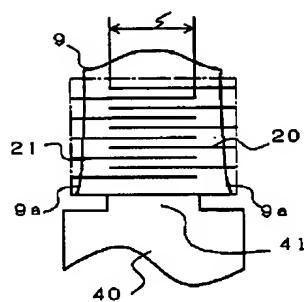
【图6】



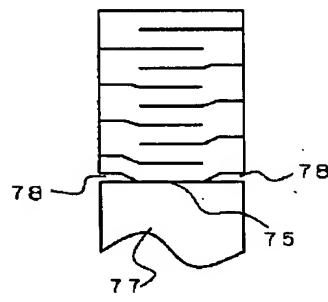
[図4]



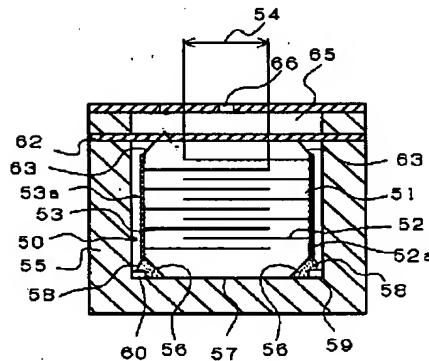
[図 7]



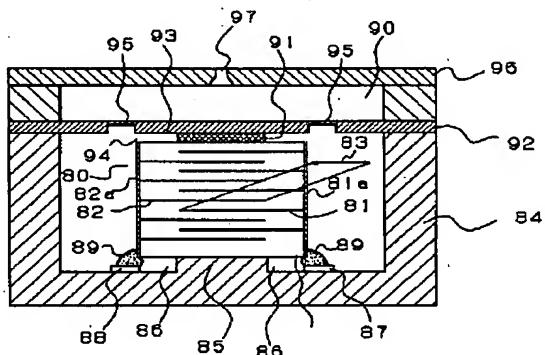
### 【図11】



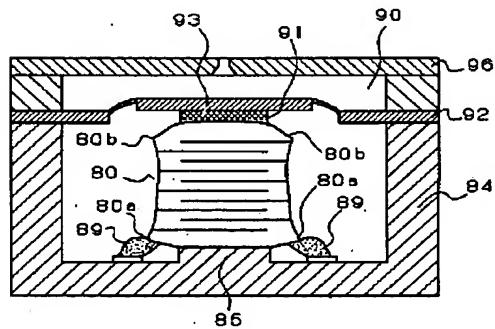
[図8]



【図12】



【図13】



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## CLAIMS

## [Claim(s)]

[Claim 1] A piezoelectric transducer constituted so that the laminating of an electrode formation material and piezoelectric material used as a segment electrode and a common electrode might be carried out by turns, an active region might be formed in a center section and it might expand and contract in the direction of a laminating A fixed substrate which fixes this piezoelectric transducer A passage configuration member which contacts at a tip of said piezoelectric transducer, compresses ink by telescopic motion of said piezoelectric transducer, and generates an ink drop It is the ink jet type recording head equipped with the above, and is characterized by for said piezoelectric transducer and said fixed substrate forming a contact field only in a portion of said active region, and fixing both only in said contact field.

[Claim 2] An ink jet type recording head of claim 1 in which it cuts off so that it may leave a portion which counters an active region of said piezoelectric transducer to a side which contacts said piezoelectric transducer of said fixed substrate and a slant face may be formed in it, and the section is formed.

[Claim 3] An ink jet type recording head of claim 1 which heights formed in a portion to which said fixed substrate counters an active region of said piezoelectric transducer were formed, and is in contact with an active region of said piezoelectric transducer with said heights.

[Claim 4] An ink jet type recording head of claim 1 to which said piezoelectric transducer cuts off into portions other than said active region of a side which contacts said fixed substrate, the section is formed in, and only an active region was fixed in contact with a fixed substrate.

[Claim 5] An ink jet type recording head of claim 1 to which said piezoelectric transducer has a lobe in an active region with thickness of an electrode formation material which constitutes a segment electrode and a common electrode, makes said lobe contact a fixed substrate, and is being fixed.

[Claim 6] Claim 1 thru/or 5 ink jet type recording heads with which adhesives which maintain elasticity even after solidifying to space formed of said clipping section are filled up.

[Claim 7] Claim 1 which said adhesives are equipped with conductivity and is performing electrical connection of a piezoelectric transducer and a lead electrode currently formed in a fixed substrate thru/or 6 ink jet type recording heads.

[Claim 8] A piezoelectric transducer constituted so that the laminating of an electrode formation material and piezoelectric material used as a segment electrode and a common electrode might be carried out by turns, an active region might be formed in a center section and it might expand and contract in the direction of a laminating A fixed substrate which fixes this piezoelectric transducer A passage configuration member which contacts at a tip of said piezoelectric transducer, compresses ink through a diaphragm by telescopic motion of said piezoelectric transducer, and generates an ink drop It is the ink jet type recording head equipped with the above, and said piezoelectric transducer is characterized by forming a contact field only in a portion of said fixed substrate and said diaphragm, and said active region, and fixing both only in said contact field.

[Claim 9] Said diaphragm and said piezoelectric transducer are the ink jet type recording head of claim 8 currently fixed through a connection member of size corresponding to said active region.

[Claim 10] An ink jet type recording head of claim 9 from which said connection member is constituted by diaphragm at one.

[Claim 11] Said piezoelectric transducer is the ink jet type recording head of claim 8 which a part of inactive field of a side which counters said diaphragm is cut off, and is being substantially fixed only with an active region.

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[Translation done.]

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## DETAILED DESCRIPTION

### [Detailed Description of the Invention]

#### [0001]

[Industrial Application] This invention relates to the ink jet type recording head which used for the driving means the piezoelectric transducer which carried out the laminating of piezoelectric material and the electrode material to the shape of sandwiches.

#### [0002]

[Description of the Prior Art] The ink-jet recording head which a pressure applies [ recording head ] to the ink held in the pressure generating room , and generates an ink drop from a nozzle orifice was roughly classified into two format of the piezo-electric formula which presses the thing and the pressure generating room of the thermal jet type which comes to hold a heater element in a pressure generating room with a piezoelectric transducer , and the latter thing did not cause deterioration to ink in order not to receive heating , but it is equipped with the feature that it can use for large uses , such as color printing . However, in order to make a piezoelectric transducer produce the displacement made sufficient for generating an ink drop, about several 100-volt driver voltage is needed, and it has the problem that big pressure resistance is required of a signal-transmission way or passive circuit elements. As it was shown in JP,4-1052,A in order to solve such a problem for example, what carried out the laminating of piezoelectric material and the electrode material to the shape of two or more layer sandwiches, and constituted the piezoelectric transducer for compressing a pressure generating room and making it expand is proposed. According to this, driver voltage can be reduced to about 30 volts, and the structure of a drive circuit or an electric supply means can be simplified.

[0003] However, there is un-arranging [ that the reinforcement falls as compared with the piezoelectric transducer using a single piezo-electric oscillating substrate ] on the relation which is carrying out the laminating of a different material called piezoelectric material and an electrode formation material.

#### [0004]

[Problem(s) to be Solved by the Invention] The place which this invention is made in view of such a problem, and is made into the purpose is offering the new ink jet type recording head which cannot make a laminating mold piezoelectric transducer able to produce unnecessary stress, and can moreover raise energy efficiency.

#### [0005]

[Means for Solving the Problem] In order to solve such a problem, it sets to this invention. A piezoelectric transducer constituted so that the laminating of an electrode formation material and piezoelectric material used as a segment electrode and a common electrode might be carried out by turns, an active region might be formed in a center section and it might expand and contract in the direction of a laminating, In an ink jet type recording head equipped with a fixed substrate which fixes this piezoelectric transducer, and a passage configuration member which contacts at a tip of said piezoelectric transducer, compresses ink by telescopic motion of said piezoelectric transducer, and generates an ink drop Said piezoelectric transducer and said fixed substrate form a contact field only in a portion of said active region, and both were fixed only in said contact field.

[0006]

[Function] If a driving signal is impressed to the segment electrode of a piezoelectric transducer, and a common electrode, only the active region where the electrode of each pole has countered will develop in the direction of a laminating. Also in a free condition, expanding of an active region will be followed as much as possible, and the side and the lower limit edge section which are not kept to telescopic motion at this time will contract to both fixed substrates. Consequently, the stress of the edge section of a piezoelectric transducer is very small as compared with the case where the edge section is being fixed, the expanding degree of the part and the electrode array direction where the contraction side moreover is not restrained becomes large, and an ink drop is made generated at high effectiveness.

[0007]

[Example] Then, based on the example illustrating the details of this invention, it explains below. Drawing 1 and drawing 2 are the assembly perspective diagrams and cross sections showing one example of this invention, respectively. The nozzle plate in which, as for the sign 1 in drawing, nozzle orifices 2 and 2 and 2 .... were drilled, The through-holes 4 and 4 for 3 to divide the pressure generating room 6, the spacer equipped with 4 ...., and 5 are the diaphragms which contact the piezoelectric transducer 9 of the piezo-electric oscillating unit 7 mentioned later, and deform to compensate for telescopic motion of a piezoelectric transducer 9. The passage configuration unit which carries out the laminating of these three members, and forms the pressure generating room 6 is constituted.

[0008] 7 is the piezo-electric oscillating unit by which this invention is characterized, and fixes the laminating mold piezoelectric transducers 9 and 9 and 9 .... at the tip of the fixed substrate 8, and the lead electrodes 10, 10, 10, ..., 11 for connecting with piezoelectric transducers 9, 9, and 9 and an external terminal on the side of the fixed substrate 8 are formed. And for the fixed substrate 8, only the plane section 13 which the portions of the piezoelectric transducers 9 and 9 and 9 .... which counter a flank are cut off and cut off, and the sections 12 and 12 are formed, and turns into the remainder is piezoelectric transducers 9, 9, and 9.. This is fixed in contact with an active region 15 ( drawing 3 ). Thus, it is mutually fixed through the pedestals 16 and 16 equipped with the slot which constitutes the ink supply way 14, and the constituted passage configuration unit and the vibrator unit are collected into the recording head.

[0009] Drawing 3 is drawing showing the details of the vibrator unit 7 mentioned above. The sign 9 in drawing With a piezoelectric transducer, respectively, the electrode formation material which constitutes a segment electrode and a common electrode, for example, silver palladium, and piezoelectric material, for example, lead titanate, by 3 thru/or 5 micrometers and 20 thru/or the thickness of 50 micrometers And one electrode 20 and 20, i.e., the segment electrodes which impress a driving signal, the electrode formation material used as 20 .... and the common electrodes 21 and 21, the piezo-electric oscillating layers 22, 22, and 22 in which an end is formed with piezoelectric material in the electrode formation material used as 21 ... It is extended to the side. Moreover, it arranges so that the other end may carry out termination near the center section, and a laminating is carried out so that the electrodes 20, 21, 20, and 21 of each pole may be piled up and it may be put together only in the center section.

[0010] If it calcinates in this condition, in a center section, the common electrodes 21 and 21 and 21 .. will carry out a lap to the segment electrodes 20 and 20 and 20 .... by fixed width of face, and this will serve as a field which produces electrostriction, and the so-called active region 15. And if the side electrodes 20a and 21a are formed in the segment electrodes 20 and 20, the side which 20 .... has exposed and the common electrodes 21 and 21, and the side which 21 .. has exposed by vacuum evaporationo etc. .... and 21 and 21, and 21 .. are connected to juxtaposition by the side electrodes 20a and 21a, respectively. each poles 20, 20, and 20 --- The electrostriction which produces the displacement for pressing the diaphragm 5 which constitutes the pressure generating room 6 from low voltage of about 30 volts, and generating an ink drop will be produced.

[0011] 8 is the above-mentioned fixed substrate, the edge of upper surface both sides is cut off and cut off, and the sections 12 and 12 are formed so that it may have the plane section 13 into the portion with which each electrode of a piezoelectric transducer 9 laps, i.e., an active region

15 and the portion which counters. In the side (this drawing C) of the side which the lead electrode 11 is formed in the side (this drawing A) of the side which the common electrodes 21 and 21 and 21 .... expose of vacuum evaporationo etc. all over the, and the segment electrodes 20 and 20 and 20 .. expose, they are piezoelectric transducers 9, 9, and 9.. According to the location, the lead electrodes 10 and 10 of two or more articles and 10 .. are formed of vacuum evaporationo etc.

[0012] Thus, the constituted fixed substrate 8, piezoelectric transducers 9 and 9, and 9 .... are in the condition of having applied non-conductive adhesives to the plane section 13 of the top-most vertices of the fixed substrate 8 thinly as much as possible, and having made piezoelectric transducers 9 and 9 and 9 .. contacting the fixed substrate 8 mostly, and it is made in agreement with nozzle orifices 2, 2, and 2 and the array pitch of .., fixes, and they are constituted by the vibrator unit 7. And it pours in so that piezoelectric transducers 9 and 9, the electroconductive glue 28 and 28 of 9 .... with which after solidification has flexibility according to an array, and 28 .. may be established in the space of the shape of a cross section of V characters formed of the end face of the clipping sections 12 and 12 of the fixed substrate 8, and piezoelectric transducers 9, 9, and 9 and a separator may be established in the side electrode 20a side, and electroconductive glue 29 is poured into side electrode 21a at the whole.

[0013] Thereby, electrical connection of the common electrodes 21 and 21 of a piezoelectric transducer 9 and 21 .. is carried out to the lead electrode 11 of side electrode 21a community again at each piezoelectric transducers 9 and 9, the segment electrodes 20 and 20 and the lead electrodes 10 and 10 with which 20 .. became independent through the side electrodes 20a and 20a and 20a.., respectively of 9 ...., and 10 .. And from these, a driving signal can be supplied alternatively [ piezoelectric transducers 9 and 9 and 9 .. ] to each by connecting electric conduction patterns, such as a flexible cable, to the lead electrodes 10, 10, 10, ...., 11.

[0014] In this example, if a driving signal is impressed to a piezoelectric transducer 9, as shown in drawing 4 (a), the electrodes 20, 20, ...., 21 of two poles and the active region 15 inserted into 21 .. will develop in the electrode array direction, and only one electrode will exist, and the inactive field which does not receive electric field will not contribute to expanding. Only the active region 15 which is carrying out the lap is supported for ...., 21 and 21, and 21 .. by the fixed substrate 8, and the piezoelectric transducer 9 — the electrodes 20, 20, and 20 of two poles — The inactive field of both sides is being fixed by the electroconductive glue 28 and 29 equipped with elasticity. Moreover, edge section 9a, If 9a sees from piezoelectric phenomena, since it is maintained by the free condition, it will develop without receiving constraint by the fixed substrate 8 as the whole piezoelectric transducer, and will press a diaphragm 5.

[0015] Consequently, the whole base of a piezoelectric transducer A is fixed to the fixed substrate B, only in deltaL, the degree (volume change) of that expanding becomes large as compared with the conventional thing (this drawing b) by which the edge sections C and C are restrained, and the energy efficiency for generating an ink drop becomes high. Since the edge sections 9a and 9a have not received constraint in coincidence, stress becomes small, and fatigue decreases.

[0016] In addition, piezoelectric transducers 9, 9, and 9 separately constituted independently in this example .... Nozzle orifices 2, 2, and 2 .. Although he is trying to fix to the fixed substrate 8 according to an array pitch As shown in drawing 5 , piezoelectric material 30 and the piezo-electric diaphragm 33 which carried out the laminating of the electrode formation materials 31, 32, and 31 and 32 .. to 30 .... by turns, and was constituted as one board It fixes to the fixed substrate 34 which cut off only the active region and was equipped with the sections 37 and 37 with adhesives, and simplification of adhesion can be attained if the slits 35 and 35 which arrive at the surface of the fixed substrate 34 from the tip of the piezo-electric diaphragm 33 are formed by the diamond saw 36 or the wire saw.

[0017] Drawing 6 shows the 2nd example of this invention, and it is the fixed substrate which fixes the piezoelectric transducer 9 mentioned above, heights 41 are formed in the portion which counters the active region 15 of a piezoelectric transducer 9, and the sign 40 in drawing is constituted so that this may be fixed only in contact with the active region 15 of a piezoelectric transducer 9. Consequently, space 42 and 42 will be formed between the inactive field of a

piezoelectric transducer 9, and the fixed substrate 40. Since the edge sections 9a and 9a of a piezoelectric transducer 9 are maintained by the condition free at the time of telescopic motion of a piezoelectric transducer 9 like the above-mentioned example, as shown in drawing 7, a piezoelectric transducer 9 expanding when a driving signal is impressed — while generating an ink drop at the effectiveness in which displacement is large and high, unnecessary stress cannot be received and fatigue of a piezoelectric transducer 9 and the fixed substrate 40 can be made small.

[0018] The side electrodes 20a and 21a of a piezoelectric transducer 9 and the lead electrodes 43 and 44 of the fixed substrate 40 are connectable by forming the lead electrodes 43 and 44 in the side of the fixed substrate 40, and needless to say, being filled up with the electroconductive glue which maintains elasticity even after solidifying to space 42 and 42. Moreover, it is clear that the piezo-electric diaphragm of one sheet is fixed to the fixed substrate 40 as this example was shown in above-mentioned drawing 5, and OFF division \*\*\*\*\* only of the piezo-electric diaphragm can be carried out at predetermined size.

[0019] Drawing 8 is what shows the 3rd example of this invention. The sign 50 in drawing Carry out a laminating to the sense which an electrode formation material counters so that piezoelectric material may be inserted by turns at the shape of sandwiches, and the common electrodes 53 and 53 and 53 .. are formed with the segment electrodes 52 and 52 and 52 .... With the piezoelectric transducer which constituted the active region 54 of the piezo-electric oscillating layer 51, the edge section of the inactive field of the side which counters the fixed substrate 55 is cut off and cut off in the center section, and the sections 56 and 56 are formed in it.

[0020] After solidification fills up the slot of the shape of V character which a piezoelectric transducer 50 is fixed to the fixed substrate 55 by adhesives in the plane section 57, and is formed with the clipping sections 56 and 56 and the fixed substrate 55 with the electroconductive glue 58 and 58 which maintains elasticity, and each side electrodes 52a and 53a and lead terminals 59 and 60 of a piezoelectric transducer 50 are connected to it.

[0021] Moreover, mist beam clipping section 63. and 63 are formed in the edge section by the side of the other end of the piezoelectric transducer 50 which is in contact with the diaphragm 62, and it consists of this example so that the roll off of the adhesives which fix a piezoelectric transducer 50 and a diaphragm 62 may be made. It prevents flowing into the crevice between the piezoelectric transducers which adjoin while the adhesives applied to the excess by this cut off and reinforcing an influx, a diaphragm 62, and a piezoelectric transducer 50 at the sections 63 and 63.

[0022] When a driving signal is impressed to a piezoelectric transducer 50 in this example, only an active region 54 develops, a diaphragm 62 is pressed, the pressure generating room 65 is compressed, and an ink drop is made generated from a nozzle orifice 66. As the piezoelectric transducer 50 was shown in drawing 9 with expanding by impression of a driving signal, it will contract in the expanding direction and the direction of a right angle, but since the edge sections 50a and 50a of a lower limit cut and lack, constraint by the fixed substrate 55 is not received, therefore a tip can deform greatly, and an ink drop is generated in high energy efficiency, and fatigue of a piezoelectric transducer 50 and the fixed substrate 55 also becomes small.

[0023] In addition, although the edge of a piezoelectric transducer is cut off by polishing etc. and he is trying to form the section positively in an above-mentioned example the green sheets 70 and 70 which suited carrying out the laminating of the piezo-electric oscillating material, and have fixed thickness as shown in drawing 10, and 70 .... and the green sheets 71, 71, 71, and 71 of an electrode formation material, if .., 72 and 72, and 72 .. are piled up Since the number of laminatings increases by the number of sheets of the green sheet of the electrode formation material with which the portion which becomes the field 74 with which an electrode laps up and down, i.e., an active region, serves as one pole from other portions, finally the heights 75 of level difference delta will arise in an active region.

[0024] It calcinates in this condition, and if heights 75 are fixed to the fixed substrate 77 with contact, now adhesives as shown in drawing 11, space 78 and 78 will be generated between the fixed substrates 77 in the both-sides section used as an inactive field. Consequently, the piezo-

electric oscillating unit which contact immobilization only of the active region 74 was carried out [ unit ] at the fixed substrate 77, and made the free condition maintain the edge section can be constituted, without requiring special processing for forming the clipping section.

[0025] It is the laminating mold piezoelectric transducer which drawing 12 shows the 5th example of this invention, the sign 80 in drawing has arranged so that the lap of the common electrodes 82 and 82 and 82 .. may be carried out to the segment electrodes 81 and 81 and 81 .... in part in the center section as mentioned above, and formed the active region 83 only in the center section. It is fixed to the heights 85 formed in the pedestal 84 with adhesives so that opposite contact may be carried out only with an active region 83, and it is fixed to the inactive field as space 86 and 86 is formed between pedestals 84. and each segment electrodes 81, 81, and 81 — after solidification is being fixed to .... and the common electrodes 82 and 82, and the lead electrodes 87 and 88 with which the lower limit was established for 82 .. in the side electrodes 81a and 82a which are carrying out parallel connection by the pedestal 84 by the electroconductive glue 89 which maintains elasticity. On the other hand, the island section 93 of a diaphragm 92 is made to contact through the connection member 91 as which size was chosen, and it is fixed so that only an active region 83 may be touched too, and space 94 is secured between the inactive field and the diaphragm 92 by the side which counters the pressure generating room 90. In addition, the signs 95 and 95 in drawing show the nozzle plate which 96 equipped with the nozzle orifice 97 for the thin-walled part formed in the diaphragm 92 again, respectively.

[0026] When a driving signal is impressed in this example, as mentioned above, only an active region 83 develops, and a piezoelectric transducer 80 presses a diaphragm 92, compresses the pressure generating room 90, and makes an ink drop generated from a nozzle orifice 97. Although it will contract in the expanding direction and the direction of a right angle with expanding by impression of a driving signal as shown in drawing 13 , a piezoelectric transducer 80 The inert segments 80a and 80a to which a lower limit is not being fixed are only being fixed by the electroconductive glue 89 and 89 in which elasticity is shown to deformation of a piezoelectric transducer 80. Since the inert segments 80b and 80b to which an upper limit side is not being fixed are also maintained at the free condition to the diaphragm 92, moreover, a piezoelectric transducer 80 As compared with the case where receive the constraint over contraction neither from a pedestal 84 nor a diaphragm 92, therefore the whole surface at a tip is being fixed to the diaphragm, an expanding degree becomes still larger. Therefore, while generating an ink drop in still higher energy efficiency, fatigue of a piezoelectric transducer 80, a pedestal 84, and a diaphragm 92 also becomes small.

[0027] In addition, although the connection member which connects the active region and diaphragm of a piezoelectric transducer in this example is constituted as another member, even if the inactive field by the side of a diaphragm cuts off a part as shown in above-mentioned drawing 8 , and it not only can constitute in the island section of a diaphragm, and one, but is made to carry out contact immobilization only of the active region at the island section of a diaphragm or a diaphragm, it is clear to do the same operation so.

[0028]

[Effect of the Invention] As mentioned above, the piezoelectric transducer constituted so that the laminating of the electrode formation material and piezoelectric material used as a segment electrode and a common electrode may be carried out by turns in this invention as explained, an active region might be formed in a center section and it might expand and contract in the direction of a laminating, In the ink jet type recording head equipped with the fixed substrate which fixes a piezoelectric transducer, and the passage configuration member which contacts at the tip of a piezoelectric transducer, compresses ink by telescopic motion of a piezoelectric transducer, and generates an ink drop Since the piezoelectric transducer and the fixed substrate formed the contact field only in the portion of an active region and fixed both only in this contact field Stress which acts on the edge section of a piezoelectric transducer can be made very small, and the expanding degree of the part and the electrode array direction where the contraction side moreover is not restrained can become large, and can generate an ink drop at high effectiveness.

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[Translation done.]

## \* NOTICES \*

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
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## DESCRIPTION OF DRAWINGS

### [Brief Description of the Drawings]

[Drawing 1] It is the strabismus exploded view showing one example of this invention.

[Drawing 2] It is the cross section showing one example of this invention.

[Drawing 3] (a), (b), and (c) are drawings showing the structure of a both-sides side for one example of the piezo-electric oscillating unit used for equipment same as the above, respectively.

[Drawing 4] This drawing (a) and (b) are drawings showing the elongation gestalt when impressing a driving signal to the recording head of this invention, and the conventional recording head, respectively.

[Drawing 5] It is drawing showing one example of the manufacture method of a piezoelectric transducer same as the above.

[Drawing 6] It is drawing showing other examples of this invention.

[Drawing 7] It is drawing showing the condition when impressing driver voltage to equipment same as the above.

[Drawing 8] It is the cross section showing the 3rd example of this invention.

[Drawing 9] It is drawing showing the condition when impressing a driving signal to equipment same as the above.

[Drawing 10] It is the cross section showing one example of a laminating mold piezoelectric transducer.

[Drawing 11] It is drawing showing the 4th example of this invention which used the piezoelectric transducer same as the above.

[Drawing 12] It is the cross section showing the 5th example of this invention.

[Drawing 13] It is drawing showing actuation of equipment same as the above.

### [Description of Notations]

1 Nozzle Plate

2 Nozzle Orifice

3 Spacer

4 Pressure Generating Room

5 Diaphragm

6 Pressure Generating Room

8 Fixed Substrate

9 Laminating Mold Piezoelectric Transducer

10 11 Lead electrode

12 12 Clipping section

13 Plane Section

15 Active Region

20 Segment Electrode

21 Common Electrode

22 Piezoelectric Material

20a Side electrode

21a Side electrode

## 28 29 Electroconductive glue

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[Translation done.]